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# IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventors ..... Jay Alan Borseth
Applicant ..... Microsoft Corporation
Attorney's Docket No. ..... MS1-240US
Title: Worldwide Television Tuning System With Country Code Based Tuning

## TRANSMITTAL LETTER AND CERTIFICATE OF MAILING

To: Commissioner of Patents and Trademarks,
Washington, D.C. 20231

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The following enumerated items accompany this transmittal letter and are being submitted for the matter identified in the above caption.

1. Transmittal letter including Certificate of Express Mailing
2. New Application–title page (listing inventor Jay Alan Borseth) plus 33 pages, including claims 1-42 and Abstract; plus a 7 page Appendix.
3. 7 Sheets Formal Drawings (Figs. 1-7)
4. Return Post Card

Large Entity Status [x] Small Entity Status [ ]

Date: April 8th, 1998 By: Lewis C. Lee
Lewis C. Lee
Reg. No. 34,656

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

# APPLICATION FOR LETTERS PATENT

# Worldwide Television Tuning System With Country Code Based Tuning

Inventor(s):
Jay Alan Borseth

ATTORNEY'S DOCKET NO.: MS1-240US

## TECHNICAL FIELD

This invention relates to tuning systems for broadcast television signals. More particularly, this invention relates to worldwide tuning systems that are configurable to various broadcast television standards and channel frequencies used throughout the world.

## BACKGROUND

Analog video standards for broadcast television differ from country to country. The broadcast television standard used here in the United States, for example, is different than the broadcast standard used in France. Conventional standards include multiple versions of NTSC (National Television Standards Committee), multiple versions of PAL (Phase Alternate Line), and multiple versions of SECAM (Sequential Couleur Avec Memoire).

Broadcast frequencies also change from country to country. Each country is assigned a range of frequencies to allot to its domestic television broadcast service. An international governing body known as the "International Telecommunications Union" or "ITU" governs the allocation of broadcast frequencies among the various countries.

The country-by-country discrepancies among broadcast standards and channel frequencies pose a problem for television manufacturers. Since each country employs a particular standard and operates within a particular range of frequencies, manufacturers must tailor their televisions to the country into which they are to be sold. Traditionally, the manufacturers have hardwired the televisions during manufacturing to comply with the standard and frequency requirements of the destination country.

Fig. 1 shows the hardware components of a broadcast television 20. It includes a tuner 22, a crossbar 24, a video decoder 26, a display 28, and speaker(s) 30. The tuner 22 tunes to a particular channel frequency to receive a broadcast television signal, which carries both video and audio data. The tuner 22 separates an analog video signal from an analog audio signal. The crossbar 24 routes the analog video signal to the video decoder 26, which converts the analog video signal to digital video data used to drive the display 28. The crossbar 24 also routes the analog audio signal to the speaker(s) or other audio components 30. It is noted that Fig. 1 represents a more modern television, which has digital capabilities. In older televisions, the crossbar 24 routes the analog video signal directly to the display 28 for depiction.

Under conventional manufacturing techniques, televisions used in different countries have different tuners 22 and video decoders 26. Televisions shipped in the United States are equipped with tuners and video decoders compatible with the U.S. broadcast standards and frequencies, whereas televisions shipped to other countries are equipped with different tuners and video decoders that are compatible with their broadcast standards and frequencies.

Country-based customization is inefficient because the manufacturer must make several versions of a product. In addition to broadcast standards and frequencies, the manufacturer might also have to contend with other regional differences, such specialized audio decoders for a particular market, or variations in picture tubes (e.g., 525 v. 625 line operation). The customization plays havoc with inventories because an overabundance of televisions for one country may not be cross-sold into another country where demand is strong.

To partially address this problem, manufacturers began using tuners and decoders that support multiple standards and frequencies. With this improvement, manufacturers are able to mass-produce one version of the television using the same components regardless of the destination country. Prior to shipping, the manufacturers program the tuner and decoder at the factory to a desired television standard and frequency range for the destination country.

While this is an improvement, it is not ideal. Video standards employed within a country may change. A country might decide to reallocate the broadcast frequencies, or perhaps adopt a different television standard, for political, administrative, or technical reasons. Televisions programmed at the factory are not capable of accommodating these changes. Accordingly, there is a need to design a television tuning system that may be upgraded in the field.

Another problem concerns portability. In the past, televisions sold into one country would typically reside in that country for the life of the product. It was less common for people to transport their televisions to different countries, unless they were permanently moving.

Today, as television tuner hardware decreases in size and continues to fall in component cost, it can be incorporated into portable computing devices, such as laptop computers. Given the portable nature of these computing devices, it is very likely that they will be used in numerous different locations throughout the world that employ different television standards and channel frequencies. Thus, there is a need for a worldwide television tuning system that is reconfigurable in the field to adapt to different television standards and channel frequencies.

## SUMMARY

This invention concerns a worldwide tuning system that may be implemented in televisions, computing devices, or other television broadcast receiving units. The worldwide tuning system is configurable to the television standards and channel frequencies of multiple different countries, and is reconfigurable in the event any of these parameters change. As a result, the worldwide tuning system may be transported to different countries and reconfigured to local television broadcasts. Additionally, the worldwide tuning system is upgradable in the field to accommodate any changes in television standards and channel frequencies used in various countries.

The worldwide tuning system is configurable based on a country's ITU long-distance country code. The tuning system maintains a country code table listing a plurality of countries according to their ITU codes. For instance, the United States has an ITU code of 1 and France has an ITU code of 33. The tuning system also maintains multiple channel-to-frequency mapping tables that provide television standards and correlate channel numbers to corresponding frequencies for associated countries in the country table. The country table indexes the channel-to-frequency mapping tables.

During configuration, a user or application selects a particular country by passing in the ITU code. The tuning system uses the ITU code to locate an entry for that country in the country code table. The table entry contains an index to an associated channel-to-frequency mapping table for the selected country. The tuning system then loads and saves the channel-to-frequency mapping table for subsequent use until a new and different ITU code is passed in. The tuning system

utilizes the television standard listed in the channel-to-frequency mapping table for decoding broadcast television signals in the selected country.

During tuning, the user or application enters a particular channel number. The tuning system uses the channel number to lookup a corresponding television frequency in the channel-to-frequency table. The tuning system then tunes to the television frequency.

In one implementation, the television tuning system is configured as a combination hardware/software architecture. The hardware components include tuner circuitry to tune to various television frequencies carrying television video signals and video decoder circuitry coupled to receive a television video signal from the tuner circuitry and to convert the television video signal to digital video data. A software layer overlying the hardware layer includes a tuner module coupled to adjust the tuner circuitry to a particular television frequency and a video decoder module to decode the digital video data according to a particular video standard.

The tuner module implements the country code table and the multiple channel-to-frequency mapping tables. The tuner module is implemented as a replaceable dynamic linked library (DLL). The tuner module supports an application program interface (API) to expose the DLL's functionality to an application program. In the event changes are made to broadcast television standards and channel frequencies within one or more countries, and as new countries are created or old countries cease to exist, a new tuner DLL can be downloaded and used to replace the out-of-date DLL without affecting operation of the tuning system.

The tuner module selects a channel-to-frequency mapping table based upon input of a particular country and outputs a video standard to the video decoder for use in decoding the digital video data. The tuner module selects a television frequency from the selected channel-to-frequency mapping table based upon input of a corresponding channel and outputs the selected television frequency to the tuner circuitry to cause the tuner circuitry to tune to the selected television frequency.

As a result, a manufacturer can make one television product, which can be shipped anywhere in the world. Once arriving at a particular country, the television product can be configured to the standards and frequencies of that country either automatically, or via a simple user interface.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of a prior art television tuner.

Fig. 2 is a diagrammatic illustration of a broadcast television system.

Fig. 3 is a block diagram of a broadcast-enabled viewer unit configured for TV reception.

Fig. 4 is a block diagram of a worldwide tuning system implemented in the viewer unit of Fig. 3.

Fig. 5 is a diagrammatic illustration of a country code table and multiple channel-to-frequency mapping tables, and the indexing between the tables.

Fig. 6 is a flow diagram showing steps in a method for configuring the worldwide tuning system of Fig. 4.

Fig. 7 is a flow diagram showing steps in a method for changing channels using the worldwide tuning system of Fig. 4.

## BRIEF DESCRIPTION OF THE APPENDIX

An attached appendix forms part of this document. The appendix contains a description of methods implemented in a tuner API (application program interface) utilized by the worldwide tuning system.

## DETAILED DESCRIPTION

This invention concerns a worldwide tuning system that is configurable to different broadcast television standards and channel frequencies used by various countries according to the countries' ITU long-distance country code. The worldwide tuning system may be implemented in televisions, computing devices, or other television broadcast receiving units. One example context for implementing the worldwide tuning system is described below.

### Broadcast System

Fig. 2 shows a broadcast system 50 having a broadcast transmitter 52 that broadcasts video and audio signals over a broadcast medium 54 to broadcast-enabled viewer units 56(a)-56(d). The broadcast medium 54 is representative of different types of distribution technologies, such as satellite, RF, cable, and the Internet. The broadcast transmitter 52 is representative of different technologies that are appropriate for the distribution medium, such as a satellite transmitter, RF transmitter, microwave transmitter, cable head end, and video server.

Three different broadcast-enabled viewer units are shown in Fig. 2. Viewer unit 56(a) is a wireless television that receives broadcast signals over a wireless medium, such as satellite or RF networks. Viewer unit 56(b) is a cable-enabled television having a set-top box 58 for receiving video broadcast over a cable

network. Viewer unit 56(c) is a broadcast-enabled personal computer (PC) that is capable of receiving a broadcast video stream from the broadcast medium (e.g., satellite, Internet, cable, etc.) and playing the video on a computer monitor or other display device. One example implementation of a broadcast-enabled PC is described in a co-pending U.S. Patent Application Serial No. 08/503,055, entitled "Broadcast-Enabled Personal Computer," filed January 29, 1996 in the names of Gabe L. Newell, Dan Newell, Steven J. Fluegel, David S. Byrne, Whitney McCleary, James O. Robarts, Brian K. Moran; William B. McCormick, T.K. Backman, Kenneth J. Birdwell, Joseph S. Robinson, Alonzo Gariepy, Marc W. Whitman, and Larry Brader. This application is assigned to Microsoft Corporation, and is incorporated herein by reference. Viewer unit 56(d) is a portable computer that is equipped with a broadcast tuner to receive broadcast signals.

Each viewer unit 56 is equipped with a worldwide tuning system that tunes to a particular broadcast frequency to receive video and audio signals and processes the signals according to a particular broadcast standard for output to a display and sound subsystem. The worldwide tuning system flexibly adapts to various broadcast standards and broadcast frequencies of different countries around the world. As a result, a manufacturer can produce just one version of a viewer unit that can be used anywhere in the world. Once the viewer unit resides in a particular country, the worldwide tuning system unit can be configured to the standards and frequencies of that county.

Fig. 3 shows an exemplary implementation of a viewer unit 56. It includes a broadcast receiver 60 (e.g., RF antenna, satellite dish, cable box, network card, etc.), a central processing unit 62, tuner/decoder circuitry 64, an input device 66

(e.g., keyboard, mouse, remote control, etc.), a display 68 (e.g., television, VGA monitor, etc.), and a sound subsystem 70. These components are coupled via a busing structure 72 that includes, for example, parallel and serial communications interfaces. The tuner/decoder circuitry 64 tunes the broadcast receiver 60 to the appropriate frequency and decodes incoming analog signals. It is noted that the tuner/decoder circuitry 64 may be implemented as a chipset within the central processing unit 62.

The central processing unit 62 has a processor 74 and memory 76 (e.g., RAM, ROM, Flash, disk drive, floppy disk drive, CD-ROM, etc.). An operating system 78 is stored in memory 76 and executed on processor 74 when the viewer unit is turned on. The operating system 78 is preferably a multitasking operating system that allows simultaneous execution of multiple applications. One preferred operating system is a Windows brand operating system sold by Microsoft Corporation, such as Windows CE, or Windows 95, or Windows NT or other derivative versions of Windows.

The viewer unit 56 runs a multimedia application 80 that provides processing support of the streaming video and analog signals received over the broadcast receiver. The multimedia application 80 is stored in memory 74 and executed on the processor 72. In the illustrated implementation, the multimedia application 80 is implemented using a technology known as Microsoft DirectShow, which provides playback multimedia streams from local files or Internet servers, and capture of multimedia streams from devices.

The multimedia application includes a modular arrangement of pluggable components known as "filters" which are connected together at interface points known as "pins" (referenced generally as number 82 in Fig. 3). A filter is a COM

(component object model) object that performs a specific task on a data stream, such as decompressing video data. For each stream, the filter exposes at least one pin. A pin is a COM object created by the filter that represents a point of connection for a unidirectional data stream on the filter. Input pins accept data into the filter, and output pins provide data to other filters. A typical transform filter has one input pin and one output pin. A source filter has one output pin for each data stream and a destination filter has one input pin. More complex filter arrangements are also possible.

Filters are arranged in a configuration called a "filter graph". During construction, a developer uses a component called the "filter graph manager" to connect the filters and control the stream's data flow.

Here, the filters 82 of the multimedia application 80 are configured to control underlying hardware elements in the tuner/decoder circuitry 64 associated with reception and playback of a broadcast signal. The multimedia application 80 also has a layer of drivers 84 that interface the filters 82 with the tuner/decoder circuitry 64.

**Worldwide Tuning System**

Fig. 4 shows a hardware/software architecture of a worldwide tuning system 100. The architecture has three layers: a software layer of filters 82, a software layer of drivers 84, and a hardware layer comprising the tuner/decoder circuitry 64. The tuner/decoder circuitry 64 has a tuner 102 that receives an analog broadcast signal at a particular broadcast frequency. The tuner is capable of tuning to a wide range of frequencies allotted to different countries.

The tuner 102 separates the broadcast signal into two analog data signals: a video signal and an audio signal. The audio and video signals are routed through

crossbar 104 to an audio decoder 106 and a video decoder 108, respectively. In this implementation, the audio decoder 106 converts the analog signal to digital audio data, which is passed to the sound subsystem 70 for further processing to provide such qualities as surround sound. In another implementation, the audio decoder passes the analog signal through without digitizing it. In this case, the audio decoder is used to control other parameters, such as volume.

The video decoder 108 converts the analog video signal to digital video data. The video decoder 108 is preferably a multistandard analog decoder that is capable of decoding video signals using one of a variety of video standards. The digital video data is stored in the memory 76 of the central processing unit 62 (Fig. 3), which is accessible by the filters 82 for processing the video data prior to display.

The worldwide tuning system 100 implements a filter graph 82 that programs the hardware tuner/decoder circuitry 64 to the appropriate frequencies and standards used in various countries of the world. The filter graph 82 includes a tuner filter 110, a crossbar filter 112, an audio filter 114, and a video decoder filter 116. These filters correspond to respective hardware components in the tuner/decoder circuitry 64, and namely the tuner 102, crossbar 104, audio decoder 106, and video decoder 108. Other filters in graph 82 include an overlay mixer filter 118, a video renderer filter 120, a tee filter 122, a closed captioning (CC) filter 124, an electronic programming guide (EPG) filter 126, and a broadcast data filter 128. The VBI filters are proxies for underlying kernel level software drivers: CC driver 125, EPG driver 127, and BC data driver 129. Although three VBI filters are shown in Fig. 4 for discussion purposes, other VBI filters can be used in

addition to, or in place of, the ones shown. A "line 21" decoder filter 131 is also provided in the filter graph 82.

Each filter has at least one input pin (represented by a box with a ">" sign inside on the left side of a filter) or at least one output pin (represented by a box with a ">" sign inside on the right side of a filter). Several filters have both an input pin and an output pin, and some filters have multiple input and/or output pins. Data flows from the tuner filter 110 through the various filters as indicated by the arrows connecting output pins of preceding filters to input pins of the next filters.

The drivers 84 provide an interface between the filters 82 and corresponding hardware components 64. The tuner filter 110 controls the tuning frequency of the tuner 102 via a tuner driver 130. The crossbar filter 112 submits routing instructions to the crossbar 104 via a crossbar driver 132. The audio filter 114 uses an audio driver 134 to control the audio decoder 106, and the video decoder filter 116 employs a video decoder driver 136 to manage the video decoder 108. The video renderer filter 120 provides display data to a display driver 138, which in turn provides pixel data to the display 68. A tee driver 123 is a kernel level instantiation of the tee filter 122. As noted above, the CC driver 125, EPG driver 127, and BC data driver 129 correspond to, and facilitate data flow for, the CC filter 124, the EPG filter 126, and BC data filter 128, respectively.

The worldwide tuning system 100 is configurable to different broadcast standards and broadcast frequencies based on ITU long-distance country codes. An ITU long-distance country code is the international calling code assigned by the International Telecommunications Union to facilitate international telephone calls. The ITU code is the number that precedes the area code in an international

telephone call. The ITU code for the United States is "01" or just "1". The ITU codes uniquely identify the countries in the world.

The tuner filter 110 has an ITU country code table 140 that lists all of the participating countries or territories in the world according to their ITU codes. The tuner filter 110 also maintains multiple international channel-to-frequency mapping tables 142 that provide broadcast standards and correlate channels and broadcast frequencies in individual countries. There might be one channel-to-frequency table for each country, or it may be possible for two or more countries to share the same channel-to-frequency conversion. It is further noted that one country might have more than one table in the event that separate regions within the country require a different broadcast standard or different channel-to-frequency mappings.

The worldwide tuning system 100 exposes an application program interface 144 (discussed below and in the Appendix) that can be used during configuration to select the correct country. The API enables applications to set video standards, set TV channels, and to get or set information about the channel frequencies. A configuration application allows a user to enter the correct country by typing in or selecting a country name, or abbreviation, via a user interface. The configuration application can convert the user-entered country to a corresponding country code and then call an API function to pass in country code to the worldwide tuning system. Once the country code is input, the worldwide tuning system 100 automatically adjusts to the appropriate broadcast standards and group of broadcast frequencies for the country.

Fig. 5 shows the relationship between the country code table 140 and various channel-to-frequency tables 142. The country code table 140 lists the

countries by their ITU long-distance codes. The country code table 140 also correlates broadcast standards with particular countries. In this illustration, the country code table 140 lists the United State, which has an ITU code of 1 and employs the NTSC standard, and France, which has an ITU code of 33 and utilizes the SECAM/L standard.

The ITU country code table 140 contains indexes to corresponding channel-to-frequency tables 142. In Fig. 5, the table entries for USA and France index to corresponding channel-to-frequency tables 142(1) and 142(33). The channel-to-frequency tables 142 in turn map channels in the countries to appropriate cable and broadcast frequencies for those countries. The channel-to-frequency tables 142 also contain the appropriate video standards for the countries. The France channel-to-frequency table 142(33), for example, correlates channel numbers 2, 3, 4, ..., J with associated cable and broadcast frequencies, and identifies the SECAM/L standard.

Fig. 6 shows steps in a method for automatically configuring the worldwide tuning system 100 to a particular video standard and set of frequencies. At step 150, the tuner filter 110 receives a particular country or ITU country code via API 144. More specifically, an application uses the method "IAMTVTUNER::put_CountryCode" to select a country. The tuner filter 110 uses the country or ITU country code to perform a lookup operation in the country code table 140 (step 152 in Fig. 6). The referenced table entry is then used to index the appropriate channel-to-frequency table 142 (step 154). The tuner filter 110 loads and stores the indexed channel-to-frequency table 142 for subsequent tuning operations (step 156). A method "IAMTVTUNER::put_TuningSpace" sets the

locale specific ID and a method "IAMTVTUNER::StoreAutoTune" saves all locale specific optimal tuning frequencies for later recall.

Locale specific tuning is an advantageous feature of this worldwide tuning system. It is particularly useful for portable situations. For instance, suppose a user is located in Seattle, Washington, USA. The user might configure the worldwide tuning system to the Seattle locale using "IAMTVTUNER:: put_TuningSpace". All channels in Seattle are scanned for optimal tuning frequencies and are then stored via "IAMTVTUNER::StoreAutoTune" as a file or other data record.

Now, suppose the user travels to Paris, France, taking along a portable viewer unit. The user can then reconfigure the worldwide tuning system to the Paris locale using "IAMTVTUNER:: put_TuningSpace". All channels in Paris are scanned for optimal tuning frequencies and are then stored in a second file via "IAMTVTUNER::StoreAutoTune".

When the user returns to Seattle with the portable viewer unit, the worldwide tuning system can simply retrieve the file with optimal frequencies for that locale. The worldwide tuning system is immediately restored for operation in Seattle, without reconfiguration and rescanning. As a result, the portable viewer unit is immediately available for TV viewing in Seattle. Similarly, the user could return to Paris and retrieve the stored frequency file for that locale, as well.

Once a mapping table 142 for a particular country is loaded, the worldwide tuning system 100 tunes to particular frequencies upon selection of various channels. At step 158, the tuner filter 110 receives a particular channel via API 144. The method "IAMTVTUNER::put_Channel" is called to input the channel number. The tuner filter 110 uses the channel to lookup the corresponding

frequency in the channel-to-frequency table 142 (step 160 in Fig. 6). The tuner filter 110 passes the frequency to the tuner driver 130, which tunes the hardware tuner 102 (step 162). The tuner driver 130 responds with information regarding the quality of the signal received at that frequency (step 164). If the quality is not optimal, the tuner filter 110 uses a search algorithm to scan for the best possible signal within the channel (step 166 in Fig. 6). The method "IAMTVTUNER::AutoTune" is called to scan for a precise signal on the channel's frequency.

**Filter Graph Data Flow Architecture**

With continuing reference to Fig. 4, the tuner filter 110 communicates tuning changes to the other filters synchronously while providing the control instructions to the underlying tuner driver 130 and tuner 102. At the beginning and end of each tuning operation, the tuner filter 110 sends a packet 170 downstream to all filters connected in the graph 82. The packet 170 contains information regarding the tuning operation in progress. The packet 170 includes the country code, the channel being tuned, the video standard, and flags indicating whether this is the beginning or end of the tuning operation. As an example, the packet 170 can be implemented as a data structure KS_TVTUNER_CHANGE_INFO, as follows:

```
typedef struct tagKS_TVTUNER_CHANGE_INFO {
  DWORD    dwFlags;                  //DS_TVTUNER_CHANGE_*
  DWORD    dwCountryCode;            //ITU Country Code
  DWORD    dwAnalogVideoStandard;    //Current Analog Video Standard
  DWORD    dwChannel;                //Channel Number
} KS_TVTUNER_CHANGE_INFO, *PKS_TVTUNER_CHANGE_INFO;

dwFlags:
  KS_TVTUNER_CHANGE_BEGIN_TUNE        Tuning operation is beginning
```

KS_TVTUNER_CHANGE_END_TUNE Tuning operation is complete

The crossbar filter 112 routes the packet to the video decoder filter 116 and audio filter 114. Even though the packet may not contain any audio instructions, the packet notifies the audio filter 114 when a tuning operation is beginning and ending. In response, the audio filter mutes the audio output between the time it receives a beginning packet and an ending packet to prevent output of noise or a distorted sound.

The video decoder filter 116 passes the packet 170 on to tee filter 122 and overlay mixer filter 118. The tee filter 122 replicates the packet and supplies it to the closed captioning filter 124, the EPG filter 126, and the broadcast data filter 128. These filters 124-128 detect whether the packet 170 is for beginning or ending a tuning operation. During the tuning transition, these filter 124-128 cease decoding the data because the data might become corrupted in the interim. The overlay mixer filter 118 passes the packet onto the video renderer filter 120.

The video decoder filter 116 extracts the video standard from the packet 170 to determine which standard is being used in the video data stream. This information, in turn, determines which VBI (vertical blanking interval) lines to decode. The video decoder filter 116 includes a VBI component 172 and a video capture component 174. Depending on the video standard, the VBI component 172 decodes certain lines of data contained in the digital video data output by the video decoder 108. This VBI data is passed to the tee filter 122, where it is sent for processing to the closed captioning filter 124, the EPG filter 126, and the broadcast data filter 128. The tee filter 122 does not replicate the data; rather, the data is treated as being read-only and a single copy is simultaneously passed to each of the VBI decoders.

The VBI data might include closed captioning information for the closed captioning filter 124, data used by the EPG filter 126 to create or update an electronic programming guide, or other data collected by the data filter 128 to provide stock quotes, whether, news, and so forth. As noted above, many other types of VBI codecs may be used to decode many different type of data embedded in the VBI portion of the television signal. The closed captioning filter 124 outputs data to a "line 21" decoder filter 131, which decodes the CC data. The decoder filter 131 passes the closed captioning data on to the overlay mixer filter 118, where it is combined with the video data.

The video capture component 174 decodes the digital video data from the video decoder 108 according to the video standard contained in the packet 170. Additionally, the video capture component 174 might further process or enhance the video data stream.

The video decoder filter 116 outputs the video data to the overlay mixer filter 118 where it is combined with the closed captioning data. The overlay mixer filter processes the video data and outputs the stream to the video renderer filter 120 for rendering. The video renderer filter 120 outputs the video data stream to the display driver 138, which drives the display 66.

To illustrate data flow through the worldwide tuning system 100, Fig. 7 shows steps in a method for changing channels. At step 180, the tuner filter 110 receives a new channel via API 144 (i.e., IAMTVTUNER::put_Channel). The tuner filter 110 uses the channel to lookup a corresponding broadcast or cable frequency in the channel-to-frequency table 142 (step 182 in Fig. 7). The tuner filter 110 generates a beginning packet that contains the country code, the new channel, the video standard, and a flag indicating the start of the tuning operation

(step 184). The tuner filter 110 passes the beginning packet to the downstream filters to inform them of the impending tuning operation (step 186). In response, some downstream filters (e.g., audio filter 114, closed captioning filter 124, EPG filter 126, data filter 128) cease processing the current data stream to avoid processing corrupt or incomplete data.

At step 188 in Fig. 7, the tuner filter 110 outputs the new frequency to the tuner driver 130, which tunes the tuner 102 to the new channel. Fine adjustment may then be performed as described above with respect to steps 164 and 166 in Fig. 6.

After the tuner 102 is tuned to the new channel, the tuner filter 110 generates an ending packet that contains the country code, the new channel, the video standard, and a flag indicating the end of the tuning operation (step 190). In response, the downstream filters begin processing the data stream.

**Tuner API**

The tuner filter 110 implements an API that enables applications to set video standards, set TV channels, and to get or set information about the channel frequencies. This interface can also determine what analog video standards your TV supports. Generally, the API includes methods for performing the following functions:

1. Retrieve pointers to supported interfaces
2. Increment reference count of tuner filter object
3. Decrement reference count of tuner filter object
4. Retrieve all analog video TV standards supported by the tuner
5. Retrieve the current analog video TV standard in use
6. Set the TV channel

7. Retrieve current TV channel
8. Retrieve the highest and lowest channels available
9. Scan for a precise signal on the channel's frequency
10. Set the country code to establish the frequency set
11. Retrieve the country code
12. Set a storage index for regional channel to frequency mappings
13. Retrieve the storage index for regional fine tuning
14. Retrieve the number of TV sources plugged into the tuner filter
15. Set the tuner input type (cable or antenna)
16. Retrieve the tuner input type (cable or antenna)
17. Set the hardware tuner input connection
18. Retrieve the hardware tuner input connection
19. Retrieve the current video frequency
20. Retrieve the current audio frequency

A detailed list of the methods in the tuner API is provided in the Appendix to this disclosure. This Appendix is incorporated into the disclosure.

**Upgrading Worldwide Tuner**

Video standards employed within a country may change from time to time for various reasons. For instance, governments might reallocate broadcast frequencies or adopt a different video standard for political, administrative, or technical reasons, or countries may be created or cease to exist. Due to these changes, the channel-to-frequency mapping tables within the tuner filter 110 may output erroneous frequency values or erroneous video standards.

In one implementation, the filters 82 are configured as dynamic linked libraries (DLLs). Any one filter may be replaced dynamically without restarting the system. For instance, in the event that certain broadcast frequencies have changed, a manufacturer or other provider can provide a new tuner filter DLL with updated channel-to-frequency tables that reflect the new broadcast frequencies. This tuner filter DLL can replace the existing, out-of-date tuner filter.

The new filter DLLs may be downloaded using several different means. As examples, the filter DLLs might be downloaded over the Internet, or broadcast as VBI data, or distributed on disk.

The worldwide tuning system is advantageous over prior art tuning systems. The tuning system enables worldwide tuning based on ITU country code, allowing it to be configured in the field rather than at the factory. Additionally, if standards or channel frequencies change, the tuning system can be reconfigured.

Another benefit is that the worldwide tuning system is portable. The worldwide tuning system can be implemented in portable computers and reconfigured to receive different television broadcasts as the user travels to different countries.

Another benefit is that the worldwide tuning system can be implemented as replaceable DLLs that are accessed via a set of APIs. As changes are made to broadcast television standards and channel frequencies, new DLLs can be downloaded and used to replace out-of-date DLLs without affecting operation of the system.

Although the invention has been described in language specific to structural features and/or methodological steps, it is to be understood that the invention

defined in the appended claims is not necessarily limited to the specific features or steps described. Rather, the specific features and steps are disclosed as preferred forms of implementing the claimed invention.

## CLAIMS

**1.** A television tuner comprising:

a country table listing a plurality of countries;

multiple channel-to-frequency mapping tables correlating channel numbers to corresponding frequencies for associated countries in the country table, the channel-to-frequency mapping tables being indexed by the country table so that selection of a country in the country table references an associated channel-to-frequency mapping table for the selected country; and

a tuning device to tune to a particular frequency within the channel-to-frequency mapping table associated with the selected country upon selection of a corresponding channel.

**2.** A television tuner as recited in claim 1, wherein the country table lists the countries according to a uniquely assigned country code.

**3.** A television tuner as recited in claim 1, wherein the country table lists the countries according to an International Telecommunications Union (ITU) code.

**4.** A television tuner as recited in claim 1, wherein the channel-to-frequency mapping tables also contain a television standard for the associated countries.

**5.** A television tuning component for a television tuning system, comprising:

a country table listing a plurality of countries; and

multiple channel-to-frequency mapping tables correlating channel numbers to corresponding frequencies for associated countries in the country table, the channel-to-frequency mapping tables being indexed by the country table so that selection of a country in the country table references an associated channel-to-frequency mapping table for the selected country and selection of a channel in the channel-to-frequency mapping table maps to a corresponding frequency.

**6.** A television tuning component as recited in claim 5, wherein the country table lists the countries according to a uniquely assigned country code.

**7.** A television tuning component as recited in claim 5, wherein the country table lists the countries according to an International Telecommunications Union (ITU) code.

**8.** A television tuning component as recited in claim 5, wherein the channel-to-frequency mapping tables also contain a television standard for the associated countries.

**9.** A television tuning component as recited in claim 5, embodied in software as a dynamic linked library stored on a computer-readable storage medium.

**10.** A television tuner incorporating the television tuning component as recited in claim 5.

**11.** A tuner, comprising:

tuner circuitry to tune to various television frequencies carrying television video signals;

a tuner module coupled to adjust the tuner circuitry to scan multiple channels within a particular locale for corresponding tuning frequencies, the tuner module storing the tuning frequencies for the particular locale.

**12.** A tuner as recited in claim 11, wherein:

upon transporting the tuner to a new locale, the tuner module scans multiple channels within the new local for corresponding tuning frequencies; and

upon transporting the tuner back to the particular locale, the tuner retrieves the stored tuning frequencies to restore operation in the particular locale.

**13.** A television tuning system comprising:

tuner circuitry to tune to various television frequencies carrying television video signals;

video decoder circuitry coupled to receive a television video signal from the tuner circuitry and to convert the television video signal to digital video data;

a tuner module coupled to adjust the tuner circuitry to a particular television frequency;

a video decoder module to decode the digital video data according to a particular video standard;

wherein the tuner module has a country table listing a plurality of countries and multiple channel-to-frequency mapping tables that provide video standards and correlate channel numbers to corresponding frequencies for associated countries in the country table, the channel-to-frequency mapping tables being indexed by the country table so that selection of a country in the country table references an associated channel-to-frequency mapping table for the selected country; and

wherein the tuner module selects a channel-to-frequency mapping table based upon input of a particular country and outputs a video standard to the video decoder for use in decoding the digital video data, the tuner module further selecting a television frequency from the selected channel-to-frequency mapping table based upon input of a corresponding channel and outputting the selected television frequency to the tuner circuitry to cause the tuner circuitry to tune to the selected television frequency.

**14.** A television tuning system as recited in claim 13, wherein the country table lists the countries according to an International Telecommunications Union (ITU) code.

**15.** A television tuning system as recited in claim 13, wherein the tuner module is embodied as a dynamic linked library.

**16.** A television tuning system as recited in claim 13, further comprising a second tuner module different from the tuner module, the second tuner module being used to replace the tuner module during upgrade without replacing the tuning circuitry and the decoding circuitry.

**17.** A television tuning system as recited in claim 13, wherein the tuner module supports an application program interface to expose functionality of the tuner module to an application program.

**18.** A television tuning system as recited in claim 13, wherein the tuner module stores a set of television frequencies that map to corresponding channels within the particular country for subsequent retrieval.

**19.** A television tuning manager for a television tuner, the television tuning manager being implemented in software stored on a computer-readable storage medium, the television tuning device comprising:

a country table listing a plurality of countries;

multiple channel-to-frequency mapping tables correlating channel numbers to corresponding frequencies for associated countries in the country table, the channel-to-frequency mapping tables being indexed by the country table so that selection of a country in the country table references an associated channel-to-frequency mapping table for the selected country;

a code segment to select a channel-to-frequency mapping table based upon input of a particular country; and

a code segment to output a broadcast frequency from the selected channel-to-frequency mapping table based upon input of a corresponding channel.

**20.** A television tuning manager as recited in claim 19, wherein the country table lists the countries according to a uniquely assigned country code.

**21.** A television tuning manager as recited in claim 19, wherein the country table lists the countries according to an International Telecommunications Union (ITU) code.

**22.** A television tuning manager as recited in claim 19, wherein the channel-to-frequency mapping tables also contain a television standard for the associated countries.

**23.** A television tuning manager as recited in claim 19, further comprising a code segment to store a set of broadcast frequencies that map to corresponding channels within the particular country for subsequent retrieval.

**24.** A television tuning manager as recited in claim 19, embodied as a software dynamic linked library stored on a computer-readable storage medium.

**25.** A television tuning manager as recited in claim 19, embodied as a computer software module that is dynamically accessible by an application program, the television tuning manager further comprising an application program interface to expose functionality of the television tuning manager to the application program.

**26.** An application program interface for a television tuning system, the application program interface being embodied on a computer-readable medium and having methods for performing the following functions:

setting a current TV channel;

retrieving the current TV channel;

setting a country code;

retrieving the country code;

setting a storage index for regional channel to frequency mappings; and

retrieving the storage index.

**27.** An application program interface for a television tuning system, the application program interface being embodied on a computer-readable medium and having methods for performing the following functions:

retrieving all analog video TV standards supported by the tuning system;

retrieving a current analog video TV standard in use;

setting a current TV channel;

retrieving the current TV channel;

retrieving highest and lowest channels available;

scanning for a precise signal on the current TV channel's frequency;

setting a country code;

retrieving the country code;

setting a storage index for regional channel to frequency mappings;

retrieving the storage index;

retrieving a number of TV sources plugged into the tuning system;

setting a type of tuning system;

retrieving the type of tuning system;

retrieving a current video frequency; and

retrieving a current audio frequency.

**28.** A method comprising the following steps:

receiving an ITU (International Telecommunications Union) code for a particular country; and

selecting, based on the ITU code, a set of TV channel-to-TV frequency mappings for use in the particular country.

**29.** A method as recited in claim 28, further comprising the step of selecting, based on the ITU code, a TV standard for use in the particular country.

**30.** A method as recited in claim 28, further comprising the step of storing the selected set of TV channel-to-TV frequency mappings.

**31.** A computer-readable medium having computer-executable instructions for performing the steps in the method as recited in claim 28.

**32.** A method comprising the following steps:

receiving a reference to a country;

selecting, based on the country reference, a set of channel-to-frequency mappings correlating channels to corresponding TV frequencies in the country;

receiving a channel; and

selecting, based on the channel, a TV frequency that maps to the channel;

**33.** A method as recited in claim 32, further comprising the step of tuning to the TV frequency.

**34.** A method as recited in claim 32, wherein the country reference is an ITU (International Telecommunications Union) code.

**35.** A method as recited in claim 32, further comprising the step of selecting, based on the country reference, a TV standard for the country.

**36.** A method as recited in claim 32, further comprising the step of scanning for a better quality frequency within the channel.

**37.** A method as recited in claim 32, wherein the step of selecting a set of channel-to-frequency mappings comprises the following steps:

looking up the country in a country table that lists multiple countries; and

indexing from an entry for the country in the country table to a particular channel-to-frequency table, the particular channel-to-frequency table containing mappings of channel numbers to TV frequencies for the country.

**38.** A method as recited in claim 37, wherein the step of selecting a TV frequency comprises the step of looking up in the particular channel-to-frequency table a TV frequency that corresponds to the channel.

**39.** A computer-readable medium having computer-executable instructions for performing the steps in the method as recited in claim 32.

**40.** A method comprising the following steps:

configuring a tuning system for operation in a first locale by determining tuning frequencies for an associated set of channels;

storing the tuning frequencies for the first locale;

upon transporting the tuning system to a second locale, reconfiguring the tuning system for operation in the second locale; and

upon transporting the tuning system back to the first locale, retrieving the stored tuning frequencies to restore operation in the first locale.

**41.** A method as recited in claim 40, wherein the configuring step comprises the step of scanning for optimal tuning frequencies for the associated set of channels.

**42.** A computer-readable medium having computer-executable instructions for performing the steps in the method as recited in claim 40.

## ABSTRACT

A worldwide television tuning system is configurable to the television standards and channel frequencies of multiple different countries based on a country's ITU long-distance country code. The tuning system maintains a country code table listing a plurality of countries according to their ITU codes. The tuning system also maintains multiple channel-to-frequency mapping tables that correlate channel numbers to corresponding frequencies for associated countries in the country table. The country table indexes the channel-to-frequency mapping tables. During configuration, a user or application selects a particular country by passing in the ITU code. The tuning system uses the ITU code to locate an entry for that country in the country code table. The table entry contains an index to an associated channel-to-frequency mapping table for the selected country. The tuning system loads and saves the channel-to-frequency mapping table for subsequent use. The channel-to-frequency table also identifies the appropriate television standard for the selected country. During tuning, the user or application enters a particular channel number. The tuning system uses the channel number to lookup a corresponding television frequency in the channel-to-frequency table. The tuning system then tunes to the television frequency. The tuning system stores a set of tuning frequencies for corresponding channels within a particular locale. If the tuning system is transported to another locale and then back to the original locale, the tuning frequencies may be retrieved from memory to restore operation within the original locale, rather than having to reconfigure the system.

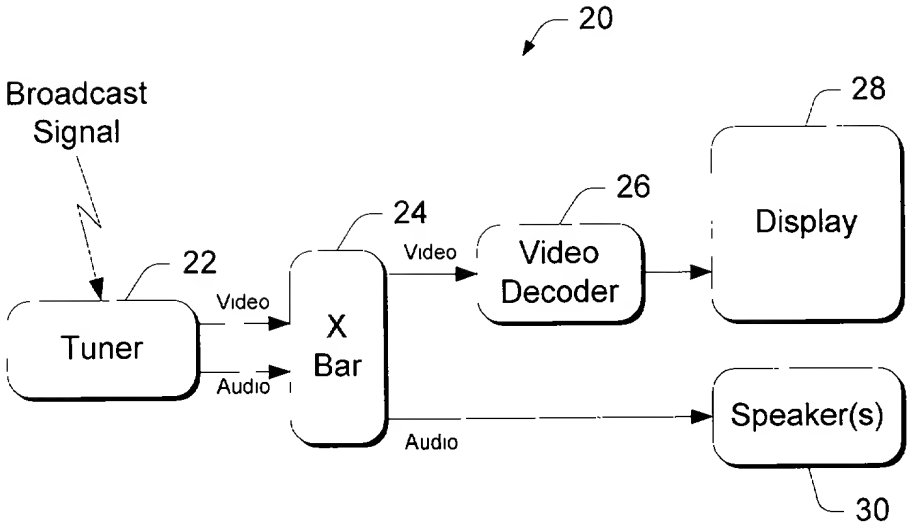


*Fig. 1*

*Prior Art*

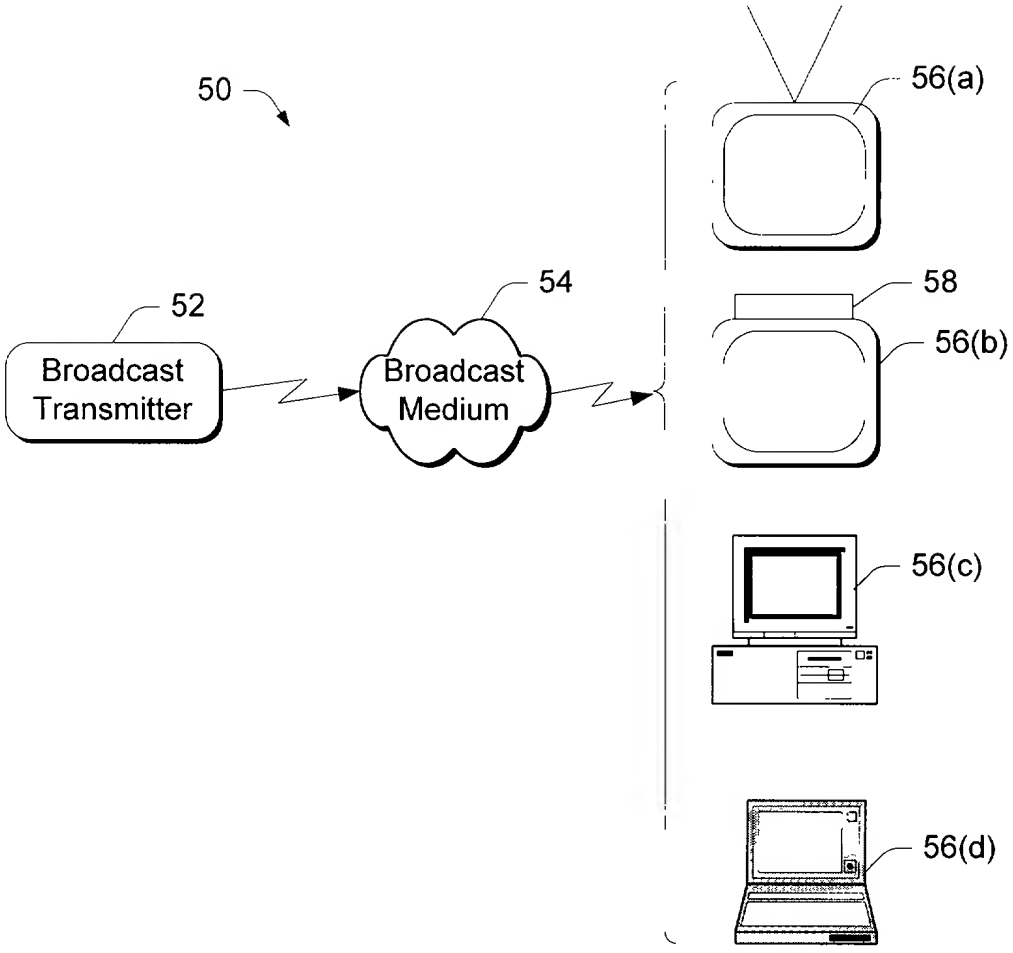
50
52
Broadcast Transmitter
54
Broadcast Medium
56(a)
58
56(b)
56(c)
56(d)

Fig. 2

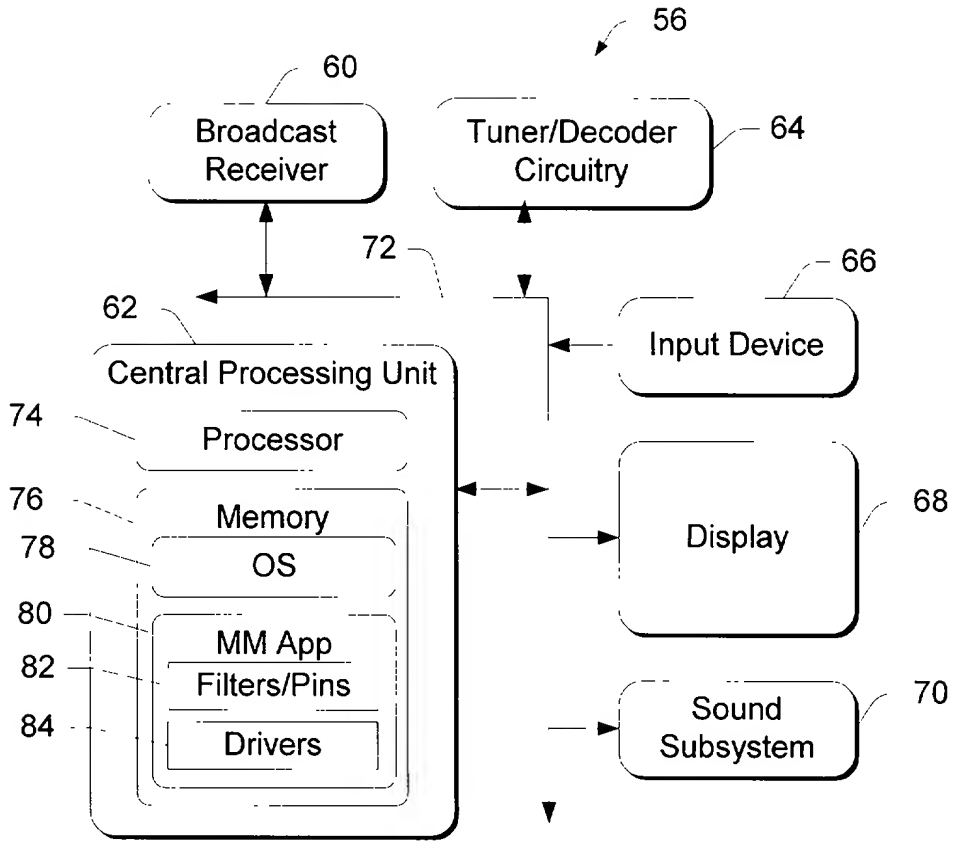
56
60
Broadcast Receiver
Tuner/Decoder Circuitry
64
72
66
62
Input Device
Central Processing Unit
74
Processor
76
Memory
78
OS
80
MM App
82
Filters/Pins
84
Drivers
Display
68
Sound Subsystem
70

Fig. 3

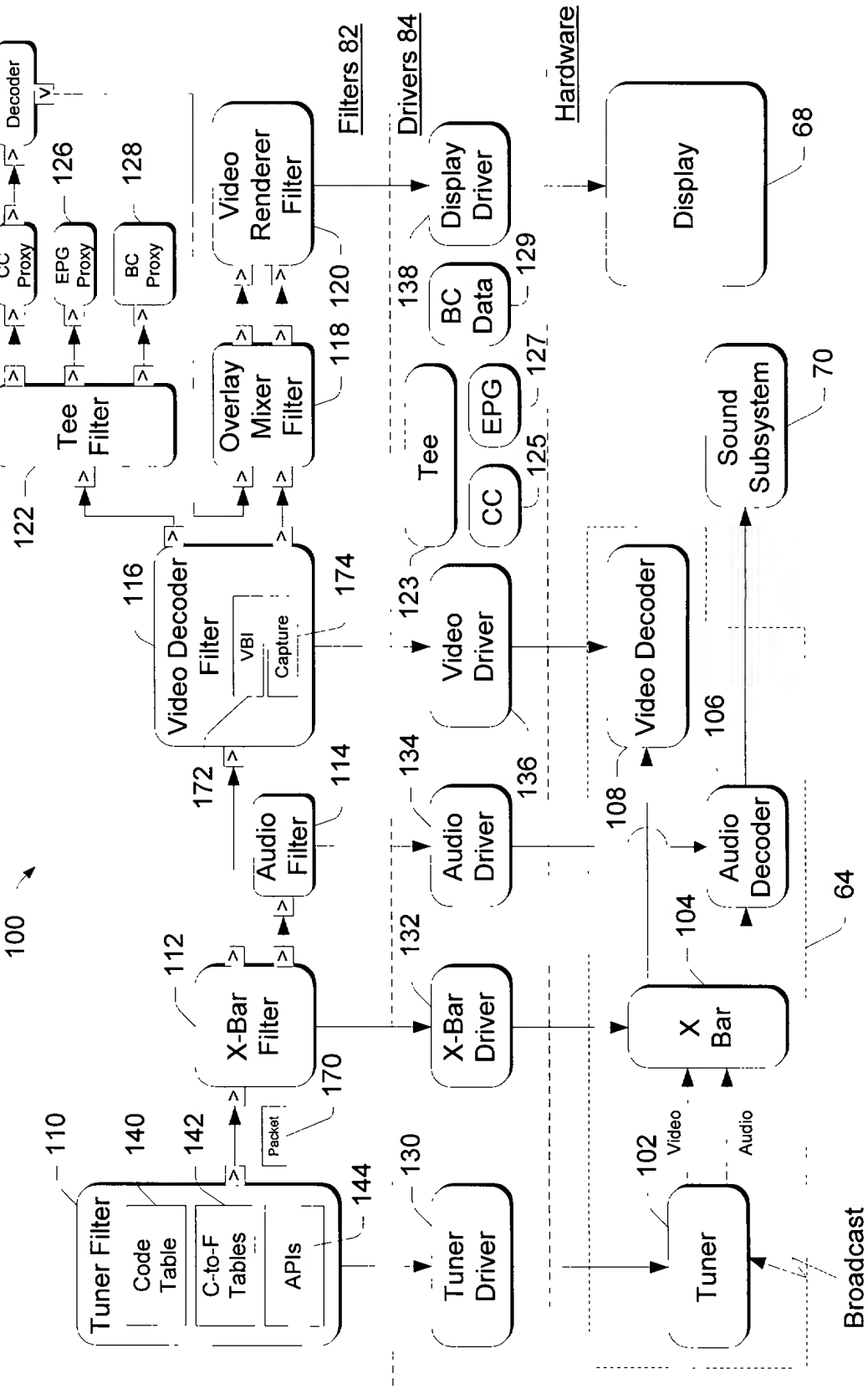
100
110
Tuner Filter
Code Table
C-to-F Tables
APIs
140
142
144
Packet
170
X-Bar Filter
112
Audio Filter
114
172
Video Decoder Filter
VBI
Capture
116
174
Tee Filter
122
CC Proxy
EPG Proxy
BC Proxy
124
126
128
Decoder
131
Overlay Mixer Filter
118
Video Renderer Filter
120
Filters 82
Drivers 84
Hardware
Tuner Driver
130
X-Bar Driver
132
Audio Driver
134
136
Video Driver
123
Tee
CC
EPG
125
127
BC Data
138
129
Display Driver
Display
68
Tuner
102
Video
Audio
X Bar
104
Audio Decoder
108
Video Decoder
106
Sound Subsystem
70
64
Broadcast Signal

Fig. 4

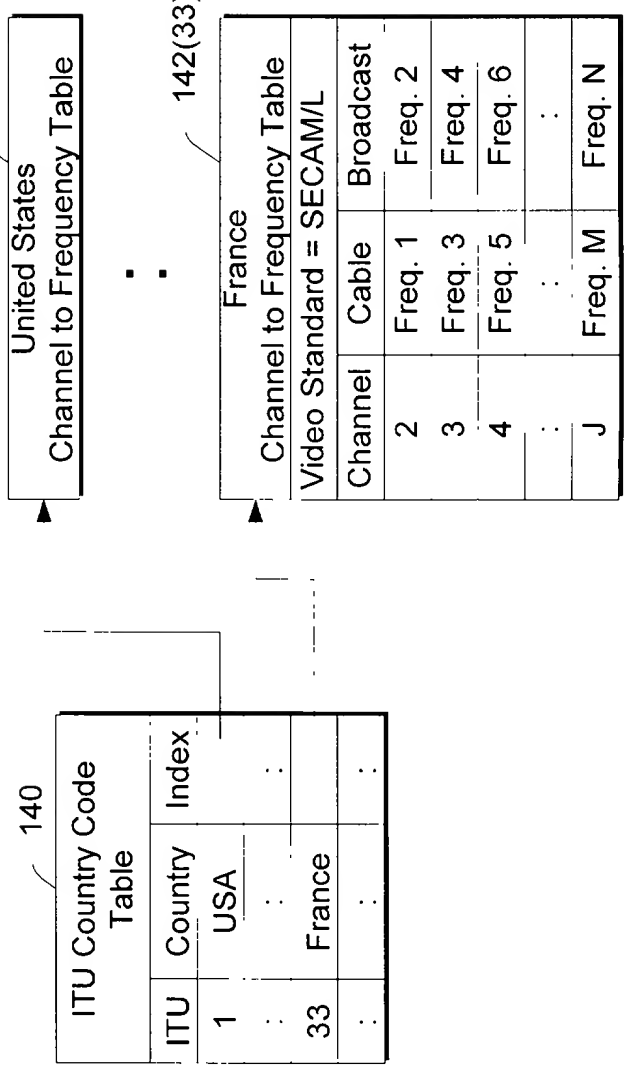
140
ITU Country Code Table
ITU
Country
Index
1
USA
33
France
142(1)
United States
Channel to Frequency Table
142(33)
France
Channel to Frequency Table
Video Standard = SECAM/L
Channel
Cable
Broadcast
2
Freq. 1
Freq. 2
3
Freq. 3
Freq. 4
4
Freq. 5
Freq. 6
J
Freq. M
Freq. N

Fig. 5

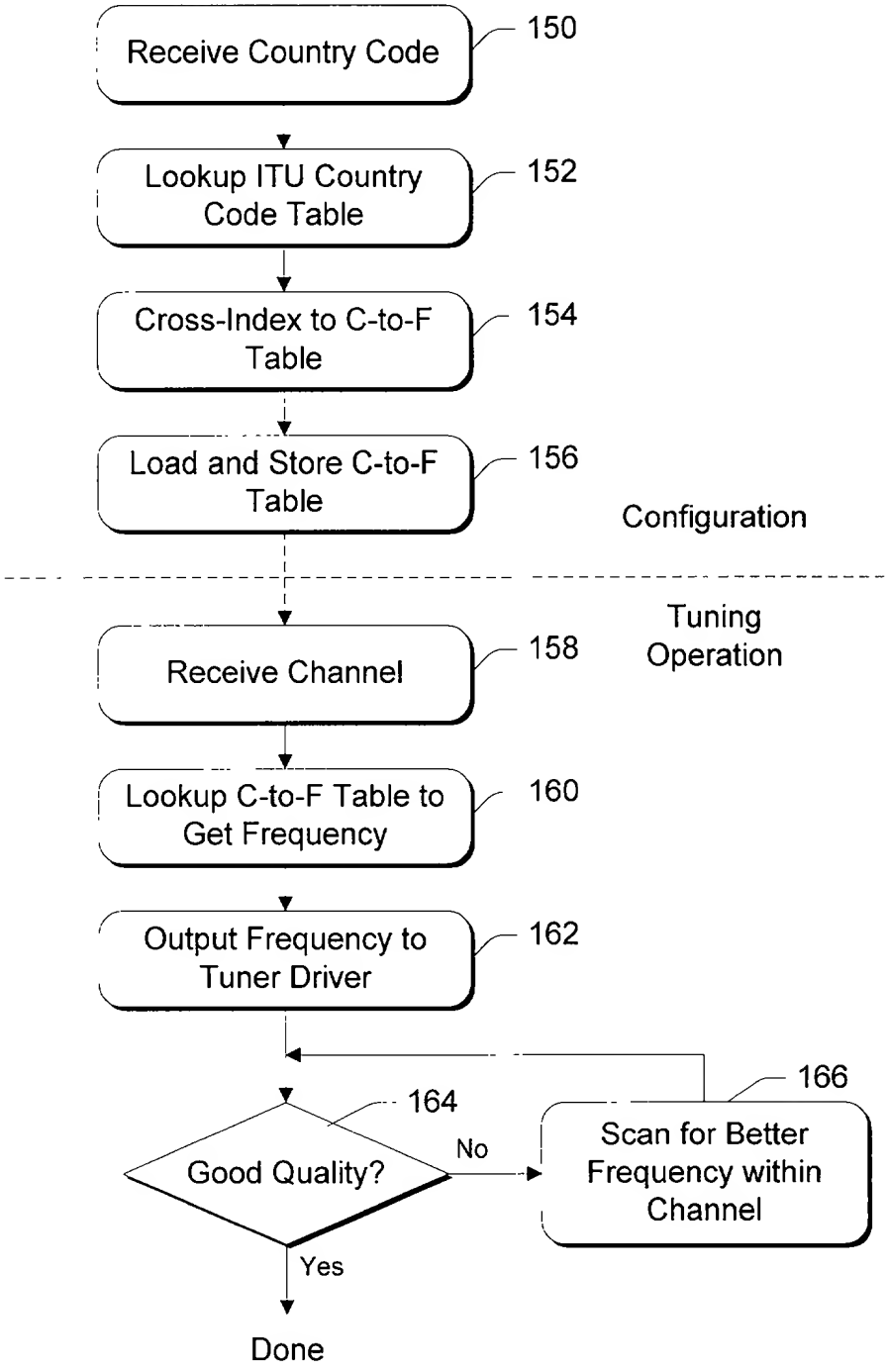
Receive Country Code
150
Lookup ITU Country Code Table
152
Cross-Index to C-to-F Table
154
Load and Store C-to-F Table
156
Configuration
Tuning Operation
Receive Channel
158
Lookup C-to-F Table to Get Frequency
160
Output Frequency to Tuner Driver
162
166
164
Good Quality?
No
Scan for Better Frequency within Channel
Yes
Done

Fig. 6

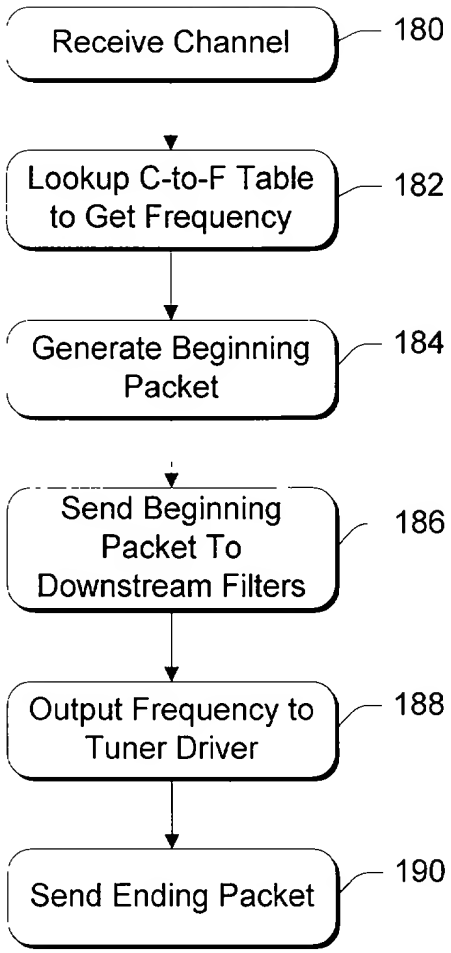
Receive Channel
180
Lookup C-to-F Table to Get Frequency
182
Generate Beginning Packet
184
Send Beginning Packet To Downstream Filters
186
Output Frequency to Tuner Driver
188
Send Ending Packet
190

Fig. 7

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